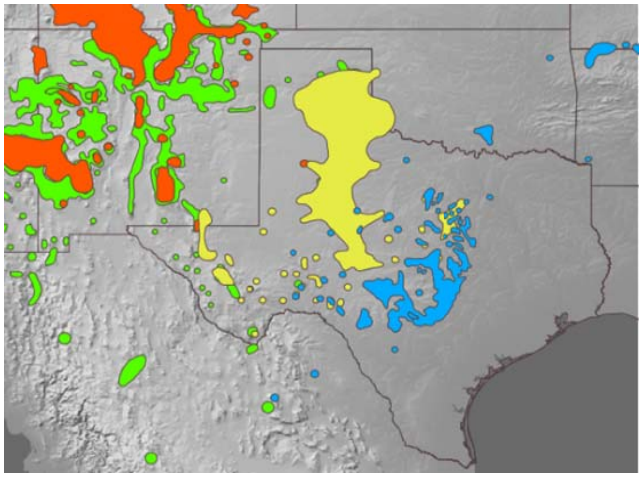
Integration of Airborne Dust Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health Decision Support Systems

Changes in our environment can have serious implications for managing and monitoring public health, both locally and globally. By understanding changes in environmental conditions and how they impact public health, we can apply this knowledge to develop early warning and forecasting systems to alert health care professionals of an impending event such as pollen. Figure 1 is an example of a pollen burst produced by *Juniperus ashei* in central Texas. New Mexico's Environmental Public Health Tracking System (NMEPHTS), funded by the Centers for Disease Control and Prevention (CDC) Environmental Public Health Tracking Network (EPHTN), aims to improve health awareness and services by linking health effects data with levels and frequency of environmental exposure.



NASA's Marshall Space Flight Center has been awarded a four-year project to *Integrate Airborne Dust Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health Decision Support Systems.* The concept of this project is to assimilate Earth science data into a weather forecast model that has been adapted to forecast pollen and to deliver output products to NMEPHTS. The project focuses on pollen bursts for four species of junipers in parts of New Mexico, Texas, and Oklahoma (Figure 2).

As a component of this project, UNM's Earth Data Analysis Center (EDAC) is developing a web-based decision support system for forecasting pollen concentration data. Designed to meet the requirements of NMEPHTS, the system includes state-of-the-art statistical analysis tools; geospatial visualization tools; data discovery, extraction, and delivery tools; and environmental/public health linkage information. Other project members are mapping pollen emission sources using SWreGAP data; observing and reporting the pollination cycle of junipers from developing cones to releasing pollen; analyzing pollen grains collected by pollen samplers; and using the Pollen Regional Atmospheric Model (PREAM) to produce forecasts of pollen events.

sampler

Burkhard pollen ground samplers (Figure 3) were placed in strategic locations during the relative pollen seasons for J. *ashei*, J. *pinchotii* (late fall through late winter in Texas and Oklahoma) and J. *scopulorum* and J. *monosperma* (late winter through mid-spring in New Mexico). Pollen grains collected by the samplers were analyzed by team members at the University of Tulsa. Results of the analyses were sent to the modelers for ingesting into PREAM. Using these analyses and pollen emission source data provided by the image processing team, initial model runs were conducted to produce the first results of pollen forecasts. Model output data are stored in an ascii format for further processing by

EDAC to develop products for NMEPHTS. The files contain data values at 3-hour intervals for a 48-hour period forecast as well as latitude and longitude information.

EDAC's post-processing script instantiates an algorithm to ingest data output files, and export a GeoTiff for each modeled output hour in a 48-hour forecast. The ingested text file is stored first in a native Python data object (a list). White space and extraneous header lines are removed, and the data are refomatted as a Python NumPy array, a two-dimensional data structure that represents the grid dimensions of the modelling exercise. These array objects are exported to a GeoTiff, and the relevant data values (timestamp, raster file location, etc.) are written into EDAC's GSToRE geospatial database.

The GSToRE geospatial database is the backbone of EDAC's RGIS and EPSCoR data repositories. The system and infrastructure have been customized to deliver stored data in a wide variety of formats, including source file downloads, WMS, WCS, as well as various vector formats. GeoTiffs created by the post-processing script are stored on the file system. PREAM outputs can be analyzed to generate county-wide statistics (e.g., mean concentration by county for a given time interval), which also are contained in GSToRE. Once data are stored in GSToRE, web map services (WMS) and web coverage services (WCS) can be called to display the data in a web-client.

The project is entering its fourth and final year. Team members are verifying and validating the model's performance and have produced early results. Figure 4 represents a visualization of pollen forecast data produced by PREAM. Figure 5 illustrates how the GeoTif products can be used with other GIS layers such as state boundaries, distribution maps of juniper species, and digital terrain data.

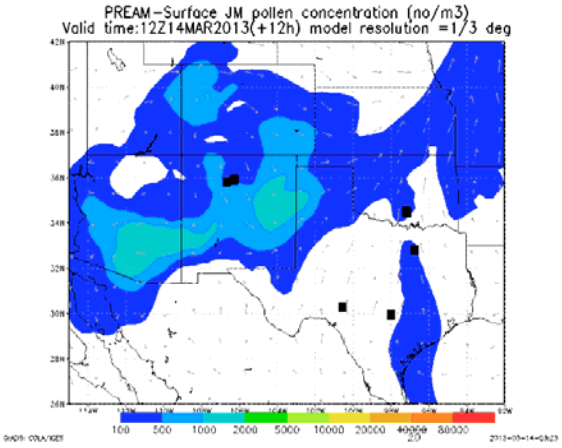


Figure 4. PREAM output of pollen forecast; 14Mar2013 at 12:00Z (5:00 am MST).

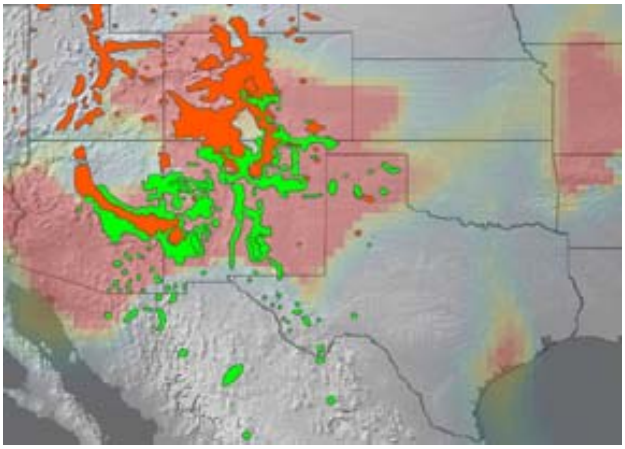


Figure 5. Using GeoTif product in a GIS application.

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